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Science and Art Gossip.

Paradoxers have strange ways. We give in our Paradox Column (but, out of consideration for our readers, in small type) the latest illustration of the ways of earth flatteners. In answer to many inquiries and some complaints about the introduction of this particular paradox, we may note that we agree with what Prof. De Morgan said about that very paradox—that it would do good, by setting many who accept the usual theory because it *is* the usual theory, examining the reason of their belief. It also serves to show how little reasoning power some human beings possess. For instance, here is a theory which sets the sun 900 miles above a circular flat surface about 6,000 miles in diameter; and here are the zetetic folk, who number, I dare say, a round dozen, if not a score, who cannot see that if there is a point vertically above a circular plane and one-seventh above its diameter from that plane, it must be in sight from every point in the plane.

Then comes Dr. Collins Symons, with his little work of 200 pages, lauded by the *Oxford Chronicle and Bucks and Berks Gazette*, stating, and to his own satisfaction *proving*, that Neptune is illuminated as brightly as the earth, or Venus, or Mercury. I am abused in that paper because I cannot make any believer in this preposterous theory understand why no one who knows anything of science accepts it, and scarce any one even thinks it worth while to take the least notice of it. I am now pointedly asked to name any physicist or astronomer except myself who has written a word against the discovery; to which I simply answer that I should be very much surprised to hear of any. It was only the accident that, as Editor of Knowledge, I received a question relating to it (probably from Dr. Symons himself), which led to my noticing it myself.

One of the odd blunders made in the *O. C. and B. and B. G.* (the believer in such an absurdity was bound to fall into many odd blunders) suggests a pretty little problem in mathematics. I said "the loss of light by atmospheric absorption, in a room of ordinary size, is inappreciable," which is of course true. To this the singular reply is made that Dr. Thomas Young pointed out that only one 2,000th part of the sun's light reaches us when he is on the horizon and his beams pass through 200 miles of air. Rooms are not usually 200 miles long, but that is a detail (as folk say I say, though I have not said so, very often, in Knowledge). Now the problem I suggest is this. Supposing 1,999-2,000ths of the sun's light lost in passing through 50 miles of air of uniform density equal to that at the sea-level (on the average), how much is lost in passing through a yard, or five yards, or ten yards? It would content the average paradoxer, I fancy, to say that since there are 88,000 yards in 50 miles, the loss would be 1 88,000 of 1,999-2,000ths in one yard, or roughly about a 90,000th—say one 10,000th part as the utmost loss by absorption in a room nine yards long. This of course would be utterly inappreciable, even with the most delicate photometer—and I was writing about ordinary eyesight.

But it would be a shame to take advantage thus of the ignorance of those who fancy Dr. Collins Symons has made a great discovery—as indeed he has, only it is of the mare's-nest order—so I give the correct solution of the problem in the Mathematical Column. It will be seen that the reduction in a yard of air is about nine times as great as that above indicated—though still the absorption even in ten or twenty yards would be inappreciable by ordinary eyesight.

Mr. Hampden, the flattener of the earth, has been really handsomely treated in these columns. When Knowledge had been but recently started, he asked for permission to air his preposterous views here; and not receiving any particular encouragement, wrote such letters as he is accustomed to write, in which the changes were pleasingly rung on the terms "liar," "coward," "scoundrel," and "dastard," with correspondingly elegant adjectives. He also threatened (and doubtless he carried out the threat) to denounce the Editor of Knowledge to all who might advertise in these pages. Yet, later on, we gave him space (having, as we believe, established our position in the world of serials) to describe and explain his views—in our Paradox Column. But he could not be persuaded to limit himself to what was thus allowed him. Instead of describing his own views, he simply maundered on, through page after page of MS. about the accepted theories of the earth's form, by which the commerce of the world is regulated, and which is justly esteemed by those who can follow the researches of Copernicus, Galileo, Kepler, and Newton. Asked to explain a few difficulties which obviously exist in his absurd theory, Mr. Hampden flies to simple abuse, the natural resource of an advocate who has no case, nor skill (as Parallax had) even to defend a bad case. He resumes his appeals to those who advertise in Knowledge, as if any true theory were ever established by libel; calls us by all the foul names which his singularly copious vocabulary contains; abuses Messrs. Wallace, Tyndall, Huxley, Spencer, Sir Edm. Beckett, and a host of other eminent men—by no means of the same school—and all this in perfect safety, since he knows perfectly well that he is not worth legal powder and shot.

But Mr. Hampden represents those who smile at his absurdities as opponents of religion. Verdant Green was in the habit, Mr. Cuthbert Bede informs us, of modestly attributing his verses, and especially his weaker verses, to one William Shakespeare. Mr. John Hampden goes considerably beyond that feeble Oxonian, for he assigns his theory, assuredly the most absurd that has ever presented

itself to the mind of man, to the direct teaching of the Supreme Being. Yet, probably, the idea that there is any outrage either to common sense or decency in this does not present itself to —— we can scarcely say to his mind, but to—what serves with him by way of a mind.

To those who ask why any attention whatever should be given to foolish paradoxes, we give the answer which De Morgan gave many years ago. Hundreds do not know by what light tenure they hold their beliefs in matters scientific, till some paradox comes to disturb their faith. We may add a reason of our own. It is most interesting to observe how limited may be the reasoning capacity, or rather how utter the incapacity of beings belonging, so far as outward features are concerned, to the human race.

Mr. Hampden (see our Paradox Column this week) illustrates also the special truth that violence is near neighbour to the extremity of weakness. When he wrote to the wife of one of our most eminent living naturalists that her husband should "be brought home to her with his brain mashed to a pulp," it was simply his way of showing the condition of his own.

It is hardly necessary to say that Mr. Hampden has had his last chance, and his name has appeared for the last time in the columns of Knowledge.

The *Globe* notes that a recent examination of elementary teachers (!) in Cape Colony brought out some singular statistics as to the distribution of population. "The candidates varied in their estimates of the population of London from 300,000,000 down to 3,000; Manchester has 200,000,000 against Leeds with 300; and Wolverhampton —there is nothing like accuracy—with 569, while 10,000, according to one candidate, is the number for Holland and Belgium together. Equally scientific accuracy was evidently the *forte* of the elementary teacher who considers that 'electricity and lightning are of the same nature, the only difference being that lightning is often several miles in length, while electricity is only a few inches,' and of another who defines electricity as 'the orbit described by the sun round the earth, but in reality the earth round the sun.' We learn also that 'a sailing vessel is propelled by means of a magnetic needle,' that it is 'propelled through the water by a steam-engine,' and 'by a certain kind of string.'"

In the April number of the *Nineteenth Century*, Mr. Matthew Arnold in the course of an interesting article on "Isaiah of Jerusalem," calls attention to the point on which we touched, to the disgust of the Rev. Urban Smith, in much such terms as we should use. "There is danger," he says, "of forgetting how short man's time is, how easily he is distracted, and diverted from his real aim, how easily tired. How many boys learning Greek never get beyond that philological vestibule in which we are kept so assiduously; never arrive at Greek literature at all. There is the danger of our losing ourselves in preliminaries, and of our being brought, by the pursuit of an impossible perfection, to miss our main design." This from such a lover of purely literary culture as Mr. Matthew Arnold, and said of those who can give a large part of their time to such culture, means a great deal.

In the same article Mr. Arnold seems to advocate the strange idea that it is more important to have an impressive than a strictly accurate version of Isaiah and the Old Testament generally—a question of some interest to those who are anxiously awaiting (as we are ourselves) the publication of the revised Old Testament. He takes the following instance. In one of the "Lessons" for Christmas Day there occur these word: "For every battle of the warrior is with confused noise, and garments rolled in blood; but this shall be with burning and full of fire." "Hardly any one," he says, very truly, "can understand these words; indeed, as they now are they cannot be understood clearly—*but* they have a magnificent flow and movement." Surely, this feeling of Mr. Arnold's is akin to that with which the old lady heard "that sweet word, Mesopotamia." Mr. Gilbert, in his splendidly-absurd song of Prince Agib, says:—

"His gentle spirit rolls
In the melody of souls,
Which is pretty, but I don't know what it means."

And this seems to be Mr. Arnold's feeling about a passage which, correctly translated, means simply, "For each shoe of him who tramples noisily, and his cloak rolled in blood, are for burning, [to be] fuel for fire." It seems better to have the real meaning than a sentence without any meaning at all. The grandeur of the poetry of Isaiah needs no tawdry trappings such as charm the readers of Robert Montgomery or Mr. M. F. Tupper.

The two waves which struck the Channel steamer *Aquila* (the captain says a third would have swamped her), in an otherwise still sea, are noteworthy phenomena. Possibly they were, in some degree, associated with the occurrence of subterranean disturbance in the volcanic district of Southern Europe.

The attendance at the second of Mr. Proctor's Lectures on Astronomy was even better than at the first. The lecture struck us (the lecturer) as being a little too long. Nearly sixty photographic views (instead of the promised forty), were exhibited, and, as in the first lecture, Mr. Field, the optician, was very successful with the work of illumination. As we write, the lecture on the moon has still to be given before this number of Knowledge appears. On Saturday, the subject will be "The Planets and their Families," with special consideration of the development of the solar system.

We propose to begin next week a series of interesting papers by F.R.A.S., on the Moon. They would have commenced earlier, but for difficulties in the preparation of an adequate reference map.

After the course of lectures at St. James's Hall is completed, Mr. Proctor goes to Ireland, where he is to deliver two lectures in the theatre of the Royal Society, Dublin, two lectures in Belfast, and other lectures. Several new series of lectures are announced for places in England on Mr. Proctor's return from Ireland.

The Telephone.—According to recent statistics, the telephone is now employed in 303 cities by 78,808 subscribers, of which 30,066 are European and 47,185 American. England is first, with 7,287 subscribers; Italy next, with 5,507 subscribers; France follows with 4,437 subscribers; and Germany last, with 3,613 subscribers. In France and Germany the telephones are worked by Government. The number of London subscribers on Feb. 28, 1881, was only 845; at the same day this year it had advanced to 2,541.

A NATURALIST'S YEAR.

By Grant Allen.

X.—PTARMIGAN.

It may be accepted as an almost unanimous axiom of epicures generally, that no game bird in the world can quite come up to the British red grouse; but the ptarmigan certainly runs that prince of the grouse-kind a good second. Though it has not the distinctive heathery flavour of the Scotch bird, derived from the nature of its food, which consists mainly of the young shoots of ling, the ptarmigan has yet very gamey flesh, and a peculiar wild taste of its own, which is similarly due to its special foodstuffs. It feeds chiefly on the fresh green twigs of the black crowberry, as well as on the whortleberry, the willow, and the sedges; and these, while less aromatic than the heather on which the red grouse subsists, are yet quite sufficient to impart a decidedly moorland flavour to the young birds. In autumn, the ptarmigan also lives on berries of various sorts; but for the greater part of the year it is forced to confine itself to leaves and the growing tops of branches; and as these are very innutritious food, it is compelled to eat large quantities at a time, so that its crop is usually very full, and it digests slowly while resting. The higher Scotch mountains still harbour a few coveys, but for the most part our supply at the present day comes from Scandinavia, where the bird remains fairly abundant. Ptarmigan, indeed, are by origin an Arctic and sub-Arctic species, wandering among high rocks at high latitudes, or among Alpine peaks a little further south; but they do not spread to America, like their neighbours the willow grouse, which are so far cosmopolitan that they ring round the world about the Arctic circle. In the eastern hemisphere, ptarmigan cling to all the more elevated positions, while willow grouse roam over the lowlands, and Scotch grouse are entirely confined to the moors and hills of our own islands. This distribution of the three kinds is interesting and significant, when taken in connection with their habits and probable origin.

Ptarmigan, which range highest north and furthest up the mountains of all, are essentially cold-weather birds. In winter, their plumage changes to pure snow-white, like the coat of the ermine and the Alpine hare; and this is the condition in which they usually reach the London market. Of course, to a comparatively defenceless bird, inhabiting a snow-clad region, such a change of colour is imperatively necessary; for, if it were brown in winter, any one of its enemies—such, for example, as the hawk or the Arctic fox—would immediately discriminate it amid the snow, and soon exterminate the whole race at once. As it is, however, the coveys are extremely difficult to perceive, and one may even walk through one without observing the fact, unless one almost treads upon a bird; for the ptarmigan have learnt to trust so thoroughly to their perfect disguise that they usually cower close to the snow whenever they perceive a man or a bird of prey, and only rise when closely pressed. Even then, they alight again after a flight to some distance, and once more settle into the soft snow so imperceptibly, that the only chance for the sportsman is to take a shot from a distance at a venture into the spot on which he saw the covey alight; he may then happen to kill a bird or two by mere accident, as they squat in the open. A sentinel is usually posted on a lump of ice to keep watch, and when he finds retreat desirable, he gives a low croak, on hearing which all the rest of the covey take to flight immediately in his wake. In summer, on the other hand, the colour of the feathers changes to a mottled grey, which still harmonises admirably with the tones of the dry grass and bracken among which they lurk. In this, their alternative dress, they resemble the ground quite as much as they did the snow in their winter plumage; and one may still walk among them without suspecting the presence of a covey, until the sentinel bird raises his low note of warning. At the approach of winter, the birds pack once more, and resume their white coats. Their neighbours the willow grouse, though also white in winter, resemble the Scotch grouse in their summer plumage; and this tint harmonises best with the general ruddy hue of the open moorlands. Our own red grouse, again, which is peculiar to the British Isles, does not need to change its suit in winter, owing to the comparative mildness of our seasons; and as the highest mountain tops in Scotland are already monopolised by the ptarmigan, it clings to the lower moors, where it has but a few days of complete snow-clad whiteness during the entire year.

Like most of the smaller grouse-kind in the eastern hemisphere, the ptarmigan is so much engaged in escaping attention that it has had no time to bestow upon the outer adornment and beautification of the male birds. Its enemies are too numerous, too powerful, and too lynx-eyed to let any unusual or brilliant plumage have a chance of success. In this respect it differs greatly from many of its American congeners, and even from the European capercailzie, long extinct in Scotland, but now reintroduced and acclimatised afresh. These larger and luckier grouse-birds, enabled by their size to defend themselves against their enemies, or inhabiting regions where foes are fewer, have abundant leisure to bestow upon their æsthetic sensibilities, and consequently have produced all sorts of ornamental crests, top-knots, ruffs, and other decorative appendages, in the first style of art, due to the constant selective action of the hen birds. The capercailzie, in the spring-time, resort to their "playing-grounds" for the sake of attracting their mates; and there they display themselves and their plumage, like peacocks, to the best advantage, so that the finest and most attractive cocks succeed in gaining over to their harem the largest number of hens. The young cocks are jealously excluded and driven away by their older rivals. Similar antics are played by the black grouse and by many American species, some of which are very handsomely ornamented with orange lappets and other beautiful appendages. All these birds are polygamists, and only the most decorated males ever succeed in attracting a posse of mates. The ptarmigan and red grouse, on the contrary, are strictly monogamous, and their two sexes hardly differ from one another in appearance. Their sober suits answer well to their modest habits of concealment and protection. It never happens, indeed, that very handsome birds take any pains to hide themselves; they are dominant races; their brilliant hues serve them as an attraction, and are always ostentatiously displayed to the greatest advantage, often at the cost of some trouble to the creatures themselves. Conversely, no birds which are protectively coloured ever possess any marked distinction between the sexes; they are skulking races, and cannot afford the risk of bright-hued crests or spotted tails. The application of this law is well seen in the cases of the black grouse and the red grouse. In the former instance the polygamous black-cock differs widely from his dingier mate, the grey hen; in the latter instance, both monogamous partners are arrayed in almost indistinguishable plumage of protective reddish brown. Ptarmigan carry the similarity between the sexes as far as any of their race, and they are also the kind in which the protective devices are most fully developed, for, besides their summer and winter dresses,

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they have actually an intermediate autumn suit of ashy grey, which helps yet further to conceal them among the sere and ashen foliage of the Scandinavian November. The ptarmigan, in short, is a strictly practical bird, who cares very little for personal adornment, but manifests a strong hereditary reluctance to be eaten up by any prowling hawk or falcon of the neighbourhood.

SUN WORSHIP.

By Richard A. Proctor.

Expanded from the opening words of Lecture on the Sun, at St. James's Hall, Wednesday, March 28, 1883.

IN old times, man worshipped the sun as a god. They knelt in adoration before his glorious orb, and raised their voices in supplication to him, as to a being who could hear their prayers and grant them what they wished. How widely prevalent that religion of sun worship was, we cannot now tell; but there are traces in the purer religions of later times, of that old system. Even in our own time, quite a number of ceremonial observances can be referred back to the time when the rising and setting sun, was regarded as a god, when the annual movement of the sun, carrying him now below, now above the equator was followed as the motion of a deity, now withdrawing, anon renewing his favouring glances, while the critical epochs when the sun-god was passing over the equator ascendingly or descendingly were celebrated in religious festivals, of which the Feast of the Passover (and our own Easter* in its seasonal or astronomical aspect) and the Feast of Tabernacles are adumbrations, though associated now with purified religious ideas. We are apt to smile at those old faiths, if we do not utterly contemn them; but in a sense they were reasonable enough at the time when they prevailed. If under any circumstances men might forget the Creator and worship the creature, it was in the case of sun-worship. To say truth, there is no apter emblem of Deity than the sun. Too glorious to be regarded save as through a veil, the sun is the source of every form of force existing on this earth. His might is exerted for our benefit, even when we see him not. In the night hours, as well as throughout the day (when he seems to "rejoice as a giant to run his course"), the sun is at work holding not only the earth, but his whole family of planets, at their due distance to receive his rays. When he is hidden behind dense clouds, when darkness encompasses the earth, he is still at work for us. Nay, the very clouds which hide his rays are due to his labour on our behalf; even when their gloom seems greatest they are preparing, under his beneficent beams, to drop fatness on the earth. Science, however, which has shown the sun as the true source of clouds and rain, hail and snow, wind and storm, of all the material forces (once themselves worshipped) at work in the air, on the sea, and on land, the nourisher of vegetation and of every form of life, shows also that he works according to natural laws. Sun-worship is shown by science to be a gross materialistic religion. It has been rejected as unworthy of reasoning men, understanding what the sun really is. In this, science has done what over and over again science has had to do, and has been reproached for doing—until, with the advance of knowledge, it has been seen that in pointing out what is material and unworthy in the cruder forms of worship, science has not been materialistic, but the reverse. Science leaves what lies at the back of each even of these imperfect religions, and the mystery which must exist in all forms of worship, if they are to be true for those who hold them. Nor need we fear that, as science shows the real nature of what in earlier times had been mysterious, the mysteries of Nature will be rendered fewer or less impressive. On the contrary, behind each law which science has interpreted, each mystery explained (if in truth science can be said really to explain anything) are even found greater mysteries, inasmuch that it may be doubted whether the human mind, as at present constituted, could bear the contemplation of the overwhelming mysteries lying (we may be well assured) behind those which science now confronts—the mysteries of universal attraction and universal repulsion, of the infinitely great and of the infinitely little, of infinite space and infinite time, of infinite variety, and, in fine, of infinite power.

* The word Easter is, in its real origin, as closely related to sun movements as the word East.

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

By Dr. Andrew Wilson, F.R.S.E., &c.

No. IX.—ABSORPTION AND BLOOD REPAIR.

DIGESTION we saw in our last paper to be that function through the operation of which food was chemically and physically altered and fitted for being added to our bodily substance. This bodily substance, indeed, the food, in its form, is destined to renew and repair. The digestive, system, moreover, we saw to be simply a long tube. As the food passes through the various portions of this tube, there are poured upon it secretions or fluids, manufactured by *glands*. The *liver* pours *bile* on the food, the *pancreas* supplies *sweetbread-juice*, the *stomach-glands gastric juice*, and so on. The end of digestion finds the food passing along the intestine and converted into a milk-like fluid called *chyle*. If we examine chyle under the microscope, we find that it contains certain globules or corpuscles (called *chyle-corpuscles*), which are not to be distinguished from the *white globules* of the blood. Under the microscope, then, this chyle certainly resembles blood in one particular. If we analyse chyle, we may find that chemistry strengthens the evidence of the microscope. We discover that chyle differs from blood chiefly in its containing a higher percentage of water than the latter fluid; in its want of coloured elements; in its larger proportion of fats, derived from the food; and in its smaller percentage of albumen.

Another fluid exists in our bodies called *lymph;* and it is necessary that we should study for a moment the resemblance of lymph and chyle. When the smallest blood-vessels of the body are watched, there is seen to be an incessant straining, through their thin walls, of the fluid part of the blood. This "transudation" (or straining through) has, of course, the result of bathing the most minute cells and elements of our bodies in the fluid (or *lymph*) which is destined for their nourishment. After the fluid part of the blood has thus nourished the tissues and parts, it becomes charged with certain waste matters. Were it allowed to accumulate in the body (as it does in certain cases of disease), we should have fluid remaining in our tissues. In a word, we should become "dropsical." In health, however, nature provides that the lymph which has escaped from the vessels will be conveyed away from the tissues. For this purpose a series of natural drainage-tubes exist in the shape of *absorbents* or *lymphatics*. These are thin-walled vessels, branching out in every part of the

body, and whose mission it is to carry the lymph to a tube lying along the left side of the spine, and called the *thoracic duct*.

In the course of its passage from all parts of the body to the *thoracic duct*, the lymph is made to pass through certain organs, situated on the tracks of the lymphatic vessels. These organs are called *lymphatic glands*. There is a collection of these glands under the arm-pit; another on each side of the neck; and another in the groin. The lymph, after passing through these glands, appears to assume a closer likeness to the blood itself, and of which, indeed, lymph is really the fluid part. From all parts of our bodies, then, these lymphatics are collecting the fluid part of the blood which has exuded through the vessels in the act of nourishing the tissues, and which is thus conveyed, after elaboration in the "glands," to the *thoracic duct*. Like the veins, the lymphatic vessels are provided with valves, which prevent the flow of lymph other than in the direction of the thoracic duct.

We must now return to the *chyle*, or digested food, which we left passing along the intestine. The chyle has to be conveyed to the blood-current, as we have seen. Now this function—that of *absorption*—commences by the chyle passing through the delicate walls of the numerous little processes called *villi*, which stud the walls of the intestine. There are millions of these villi on the lining membrane of the intestine, each villus varying in length from half a line to one-fourth of a line. Inside each villus one or two little absorbent vessels (here called *lacteals*) are found. The chyle is taken up by these vessels, and thus passes out of the digestive tube. Following up the chyle in its course, we discover the absorbents which have received it, to pass away from the intestine across the *mesentery* (or fold of the lining membrane of the abdomen), and finally to end in the *thoracic duct* at its lower portion. In their course these absorbents, like those of the body, pass through glands, which effect some change in the constitution of the chyle, and probably assimilate it more nearly in character to the blood.

It therefore follows that the thoracic duct must contain a mixture of at least two fluids—*chyle* from the digestive system; and *lymph*, or the fluid part of the blood, gathered from the body at large. We have next to inquire whither these fluids are conveyed by this duct. The thoracic duct can be traced readily enough in its course upwards and along the spine. On the right side of the body a smaller duct exists; but, for our present purpose, we may concern ourselves simply with the principal duct, that of the left side. Ascending in its course, we find that at the root of the neck, on the left side, the thoracic duct opens into a large vein (or at the junction of two veins); and we, therefore, arrive at the highly interesting fact that it is in this region that fresh supplies of matter—chyle and lymph—are poured into the blood. The latter fluid, renewed and replenished, is thus adapted for its ceaseless work of repairing the bodily waste; and the chyle and lymph, mingling with the blood, are swept onwards to the lungs, and thence start, as part and parcel of the pure blood, on the mission of bodily regeneration.

In connection with the function of "absorption," which we have just discussed, mention must be made of the *spleen*. This organ is one of the "ductless glands," or those possessing no outlet. The thyroid gland in the neck, and the pineal gland of the brain, are ranked, with other glands, in this category. The spleen itself lies to the left side of the stomach, and weighs from 5 oz. to 7 oz., measuring in length about 5 in. or 6 in., and in breadth 3 in. to 4 in. Its colour is a bluish-purple, and is of soft, pulpy texture. A large artery enters the spleen, and a large vein leaves the organ. Through the spleen, therefore, a continual circulation of blood takes place. The spleen—long a mystery to physiologists—is now regarded as a lymphatic gland, devoted to the work of elaborating the elements of the blood. We know that the blood which leaves the spleen contains more minute globules than the blood which enters the organ. Hence, we conclude that in the spleen-pulp these globules are manufactured. It is also probable that the red blood globules are also altered and transmogrified in the spleen; which, thus, from the fabulous function of generating the "evil humours" of the body—witness, in proof of this, the still common expression, "a fit of the spleen,"—has taken rank as an important blood-gland. The spleen, when enlarged, may be removed from the body of man and animals, without any apparent or serious disturbance of the health. In such a case, it is probable that the other lymphatic glands perform its work.

TRICYCLES IN 1883.

By John Browning,

Chairman and Treasurer of the London Tricycle Club.

TWO-SPEED GEARINGS.

JUST at the present time the great majority of tricyclists are devoting a deal of their attention to two-speed gearings. Most of my readers will know that by this term is meant some contrivance by which the tricycle can be driven at a low rate of speed, but with a proportionate gain in power up hill, and at a high rate of speed, with a proportionate loss of power, down hill, the change from one rate of speed to the other being made without stopping the machine.

As most riders are anxious to obtain a machine fitted with such a contrivance, or to have such an arrangement adapted to a machine they possess, I think I cannot do better than place before them the information I have obtained on the subject; much of which is the result of actual experience. Although there are, as yet, actually very few tricycles in existence with two-speed gearing, for the last three years, I have, from time to time, had machines of different kinds, both single and double (that is, for one rider or two), geared up and down from as low as 22 in., to as high as 50 in., and I have ridden one single machine belonging to my friend, Mr. Salmon, geared up to 57 in. This experience has enabled me to form an opinion as to the best proportion which should obtain between the two gearings, and this is the most important point in such a contrivance, and one which experience only can determine.

To simplify my remarks as much as possible, I must say that by a gearing of 22 in. I mean that one revolution of the crank would, with this particular arrangement, drive the tricycle as far as if it had been fitted with a driving-wheel or wheels 22 in. in diameter. Yet in some of the machines with which I experimented, the driving-wheels were as small as 30 in., while in others they were as large as 48 in.

I found then that 22 in. was too low for a double tricycle for driving up a tolerably steep incline when only one rider was working, and 50 in. was too high for me for a light single machine; about 44 in. for such a machine gave me a higher rate of speed with less exertion, though of course to accomplish this I had to pedal much faster.

But there is a great difference in this respect between different persons. Some riders prefer a light machine geared up to about 60 in., though this compels them to

walk up nearly all hills, and makes any tolerable incline hard work. Very few riders care to have a machine geared lower than 48 in. The rapid motion of their legs in pedalling, and the greater number of revolutions the pedals have to make to cover a given distance, tires them more than having to press harder on the pedals.

The proportion between the two speeds required by any rider will, however, I think, be the same. This amount will, I believe, be certainly not less than 16 in., and not more than 25 in., and it will, I believe, in most instances be about 20 in.

For a double machine, in which one rider will probably prove a weak driver, for instance, the two speeds will be 28 in. and 48 in., 30 in. and 50 in., or 32 in. and 52 in. For a single machine of rather strong build, weighing about 80 lb., for a heavy, powerful man the proportions may well be 35 in. and 55 in.; while for a very light roadster, weighing less than 60 lb., the speeds, always preserving the same proportion, may be 40 in. and 60 in.

By the kindness of Mr. Shaw I have had the advantage of trying the Crypto-dynamic two-speed gearing. I tested the machine at Surbiton, and I could not find any hill steep enough to test the hill-climbing power of the machine in the neighbourhood. The slow speed of this machine was 22 in., and the high speed 56 in.

We are indebted to Grout for the first two-speed gearing; and with a perseverance which does him the greatest credit, he has made successive improvements in his gearing, and has latterly manufactured and introduced a new contrivance by another inventor, which will probably eclipse his own. The Crypto-dynamic gearing, to which I have alluded, cannot, unfortunately, as yet be obtained. This contrivance has successfully withstood some rough work, and has certain special advantages peculiar to itself. The two-speed contrivance of the St. George's Foundry Company is worked by means of two chains, either of which can be thrown in or out of gear at pleasure. This contrivance possesses the great advantage that if either of the chains should break, or the gearing get out of order, the rider would be able to drive home with the other chain.

Britain's two-speed gearing seems to me the simplest, and likely to weigh the least, and be the most economical in price. Against these advantages we have to reckon two drawbacks: the machine must always drive through the gearing, so that it is always under strain; and the gearing cannot be thrown out of action so as to allow the pedals to run free and act as foot-rests when running down hills.

The various contrivances I have referred to could not with advantage be described without drawings, and I have said but little in this article as regards their details, or the theories on which they are based. The reason I have treated the subject in this manner is because I have received numerous letters from readers of KNOWLEDGE, asking me to make my articles on tricycles as practical as I can.

In one or two tricycling journals it has been suggested that twelve inches would be a sufficient difference between the high and low speed gearing. I do not think the writers can have ridden with machines which have been geared up and down more than this, or they would have known that such a difference will not give the full benefit to be derived from such a contrivance. For my own riding I prefer 18 inches difference to 20 inches.

A suggestion also has been made that one of the two speeds that is the fastest with the quick gearing, should be exactly suited to the rider's general requirements, and the slow gearing only brought into action for steep hills.

This I cannot agree to. The result of such an arrangement would be to give faster pedalling than is convenient to most riders, or a lower rate of speed than they might easily obtain, both on the level and when riding up ordinary inclines.

A machine capable of being driven at two different rates of speed, only with the same pedalling, should not be geared down sufficiently to ride easily up a hill with a rise of one foot in ten feet. The rider will gain greatly by walking such a hill, and gearing his machine so as to travel at a faster pace up a moderate rise. Steep hills occur only seldom on most good roads, and occupy only a very small portion of the ground to be covered, and nothing is gained by toiling up at a slower pace than they can be easily mounted by a good walker.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—IX.

IN continuing our remarks on the Wheatstone Bridge, we shall endeavour to show that in a given circuit the fall of a potential varies as the resistance of the conductor, and that this fact lends itself very opportunely to an investigation of the electrical conditions of a wire.

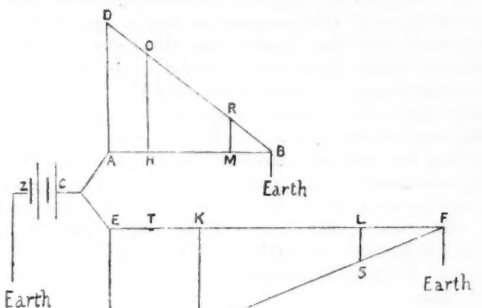


Fig. 1.

In Fig. 1 there are two wires (A B and E F) similar in quality and cross-section, but unequal in length, A B being, in this instance, half the length of E F. The potentials at A and E (represented by A D and E G) are obviously identical, and B and F being to earth (Zero), it follows that the fall from A to B is the same as that from E to F. The fall in the circuit containing A B is, therefore, twice as rapid as the fall in the other circuit through E F, and the proportionate parts in each circuit will, therefore, be charged to the same potential, and so give evidence of equal falls. For instance, H and K both being one-fourth of the distance from A to B and E to F, respectively, will be at the same potential represented by the equal vertical lines H O and K P. So likewise will M and L, three-fourths the distance from A and E, be at the same potential, the vertical lines M R and L S being equal. A galvanometer inserted between H and K, or M and L, would therefore remain passive and indicate the absence of any current. As indicated in our preceding article, were H joined to L (through a galvanometer), the needle would be deflected, say to the right, by a current passing *from* H to L. On the other hand, by joining H to any point between E and K, say T, the current would flow *to* H from T, and the needle would be deflected in the opposite direction—that is, to the left.

It is not always, however, that we wish to measure the conditions of a wire of uniform structure and thickness throughout. Were it so, we might in many instances answer our purpose, at least approximately, by simple linear measurement. But let us suppose, for example, that, in Fig. 2, A B is a line four miles long, of which the first mile, A D, has only one-third the specific conductivity of the remaining three miles of thicker wire. In other

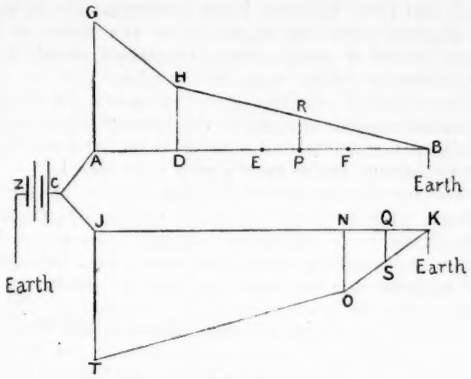


Fig. 2.

words, letting the resistance of A B be 30 Ohms, then the lengths D E, E F, and F B each offer but 10 Ohms, and will, therefore, together offer 30 Ohms. The point D is thus in the centre of the resistance—that is, there are 30 Ohms resistance on each side of it. The potential at D should therefore be half of what it is at A. The fall throughout the wire is that illustrated by the line or lines G H B. This fall from A to D is there shown to be same as the fall from D to B,—a wire three times the length of A D, but offering only the same amount of resistance to the current, and giving the current, in fact, an equal amount of work to perform in traversing it. J K is another line of four miles, three of which, J to N, offer, at 10 Ohms per mile, a total resistance of 30 Ohms ; while the fourth mile, N K, being of proportionately smaller wire, offers 30 Ohms. N therefore is in the centre of the resistance offered by J K, and the potential at N will be half that at J, as is indicated by the vertical line N O being half the length of J T. N O is necessarily equal to D H, and consequently a galvanometer inserted between D and N is not affected. Similarly P is midway between D and B ; so also is Q between N and K. P R is equal to Q S ; therefore the potentials at P and Q are the same, and, as a consequence, no current would flow through a galvanometer connecting P Q.

Analysing these different experiments, we conclude that (granting first that where two points are of the same potential no current will flow between them, and that if there is no current there can be no effect exerted upon a galvanometer placed between those points) :—

1. Potential may be represented by longer or shorter lines drawn at right angles to the wire.

2. The fall of potential may be represented by inclined lines connecting the free ends of the vertical lines above referred to.

3. In a wire of uniform quality and size, the fall is uniform throughout, and may be represented by one straight inclined line.

4. In a wire of varying quality or size, the fall will be variable, and will vary directly as the resistance of the different parts.

5. If in two similar wires of unequal length, or in any two wires of unequal resistance, we connect a point a certain distance (measured in Ohms) along one line, to a point on the other line at the same proportionate resistance-distance from its terminals, there will be the same potential at the extremities of the connecting wire, and no current will flow through it.

Summing up these deductions, it will be apparent that (referring to "Electrical Measurement—VIII," Fig. 2, Knowledge, No. 68) :—

6. When we have succeeded in bringing the galvanometer permanently to rest (whether the battery circuit is completed or not), we have effected a balance in which the proportion A bears to the unknown resistance D is the same as the proportion between B and E. We may, therefore, express the proportion as a simple rule of three sum :—

$$B : E :: A : D \text{ or } B : A :: E : D$$

To take an example, let A offer 100 Ohms, and B 10 Ohms. Then, supposing we get a balance when E offers 500 Ohms, the problem will work out thus :—

$$B : A :: E : D$$
$$\text{that is, } 10 : 100 :: 500 : 5{,}000$$

5,000 Ohms is, therefore, the resistance of the line or coil D.

For our readers (with three small but known resistances) to apply this to the manufacture of a resistance coil, ranging up to 400 Ohms (or higher, if necessary), is not difficult.

Where only a small resistance is required—such, for instance, as ·1 of an Ohm—it is advisable to join side by side a number of wires offering a higher resistance. A short length of No. 35 or 36 copper wire offers, say, ·4 of an Ohm. Two such pieces of wire coiled together will offer only ·2, and four pieces only ·1 of an Ohm. Such an arrangement will be found much more satisfactory. In coils ranging up to about 10 Ohms, thin copper wire may be used. German silver wire should be resorted to for coils of higher resistance, because of the high resistance of that metal as compared with copper.

We must, however, defer our observations on the completion of a convenient set of "Bridge" apparatus until our next article.

PERIODS OF THE AURORA.

MR. SOPHUS TROMHOLT contributes a paper in Danish to the Meteorological Society of Denmark on the above subject, and M. T. Terby, of Louvain, gives an account of it in *Ciel et Terre*, Feb. 15, 1883, from which we extract the following particulars.

Discussing reports of auroras seen at Godthaab, in South Greenland (64° 11′ N. lat., 54° 6′ long. W. of Paris), Mr. Tromholt observes that they show a totally different state of things from what occurs in lower latitudes. Wolf, of Zurich, says not only is there no parallelism, but, on the contrary, an almost diametrical opposition between the frequency of auroras and of sun-spots in the above reports. Observations by Rudolph, at Jacobshavn, Greenland, show that the maximum of auroras follows two years after minimum of sun-spots, and that the following minimum arrives almost in the same epoch as the highest point in the sun-spot curve. Bloch's observations at Godthaab, though too short to be conclusive, indicate that the number of northern auroras reaches a high figure near the epoch of minimum sun-spots, and that the number diminishes as the spots increase. Observations at Iviktut, Greenland, from 1875 to 1880, and at Stykkisholm, Iceland, show

that the minimum of auroras coincides with the maximum of spots, and *vice-versâ*.

According to Weyprecht, the auroral zone, or terrestrial zone of greatest frequency, experiences an oscillation which moves it towards the south at the period of the equinoxes. At the winter solstice, this zone takes up a more northerly position, which coincides with the fact that a maximum of auroras is then observed in polar, and a minimum in temperate regions. Tromholt confirms this, and says towards the autumnal equinox the auroral zone tends towards the south, then passes northwards, to reach its most northerly position towards the solstice; after which it proceeds south and reaches its southern maximum towards the spring equinox; after which it turns again northwards. He also finds that while evening auroras which appear in the zenith, or more north, are less frequent than auroras of the south, these conditions are reversed as regards the morning auroras. The auroral zone suffers a displacement in twenty-four hours, so that during the night it is directed towards the north. This explains the diurnal period established for mean latitudes, and the fact that the northern aurora attains its maximum some hours before midnight, and diminishes afterwards. He also finds that during the period of eleven years the auroral zone is displaced laterally, so that during the minimum of solar spots it inclines more to the north than during the spot maximum. Also, that the maximum of auroras, which coincides in temperate zones with the maximum of spots, is due to the fact that the auroral zone is then in its most southern position—when the polar regions have a minimum of auroras; on the contrary, the auroral zone has its most northern position when solar spots are at a minimum, when fewest auroras occur in temperate regions, and most in the polar region. Thus the three periods of the northern aurora—the undecennial, the annual, and the diurnal—are dependent upon the same cause: the oscillation of the auroral zone between north and south.

The most splendid aurora ever recorded in Belgium was totally invisible at Godthaab, which coincides with the above statement concerning the auroral zone.

MR. WHISTLER'S ETCHINGS.

WHILE Mr. Whistler's staring study in yellow and white was open to the public we did not notice it; for notice would have been advertisement, and we did not choose to advertise him. He has shown that he likes to be talked about at such times; and it was pretty obvious that the scurvy little brown-paper-covered catalogue was meant to invite such comment as would have served his purpose in this respect. Comment now can do no harm—and can do Mr. Whistler no good; now, therefore, is the proper time for comment to come.

Of the arrangement in yellow and white, we note that it was simply an insult to the visitors,—almost intolerable to any one possessing an eye for colour,—which Mr. Whistler, fortunately for him, does not—and absolutely sickening (in the strictest sense of the word) to those at all sensitive in such matters. "I feel sick and giddy in this hateful room," remarked a lady to us after she had been there but a few minutes. Even the common cottage chairs, painted a coarse yellow, did not solace the visitors; and the ornaments on the mantelpiece, something like old bottle-necks, only excited a faint smile in the sickened company.

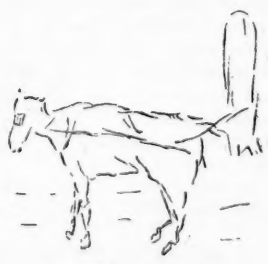
Mr. Whistler's catalogue, however, is our present game. He takes for its motto, "Who breaks a butterfly upon a wheel?" But Mr. Whistler mistakes his vocation. He is no butterfly. He might be compared, perhaps, to a bird—the bird that can sing but won't. If one judged, however, from some of his etchings, one would say a spider was nearer his mark. But a butterfly! the emblem of all that is bright and beautiful in form and colour! Daniel Lambert might as reasonably have taken the part of the Apothecary in "Romeo and Juliet," or Julia Pastrâna have essayed the rôle of Imogen.

After this quiet claim to the character of a butterfly,—as if an owl (Mr. Whistler loves nocturnes) should pose as a Paphian dove,—he appended to the titles of his etchings, instead of much-needed explanation, certain lines from criticisms which men like Ruskin, Colvin, and others have passed on him,—criticisms confirmed (though confirmation was not needed), by the Press of this country, the Continent, and America,—which is indeed breaking a rather unpleasant spider upon a very large wheel.

He honours KNOWLEDGE with the first place, though we disclaimed all wish to criticise what is, indeed, altogether beneath criticism. "Criticism," we said (very truly), "is powerless here, because one who found Mr. Whistler's recent pictures and drawings anything but insults to his artistic sense could never be reached by reasoning." So we passed on—with a *meliora canamus*. However, Mr. Whistler takes our "Criticism is powerless here" as a sort of text. We can afford him the laugh he would raise by taking these words from the context. Even as they stand they suit very well. Criticism *is* powerless with him in many different ways. It is powerless to correct his taste for wilfully drawing ill. If a school-girl of ten showed such a picture of

A memory from No. 1, pleasingly called by Mr. Whistler a Glass Furnace, but which might be anything, from an inside room in Noah's Ark to a warm corner in Hades.

a human being as this, for instance, we might criticise usefully enough. We might point out that no human being (we suppose the thing is intended for a human being, but it may be meant for a rag-bag) ever had such features or such a shape. But of what use would it be to tell Mr. Whistler as much? He knows it already, only he despises the public so much that he thinks it will do well enough for them.



A reminiscence from No. 33—Alderney-street; but the animal (we suppose) represented is not an Alderney cow, though certainly not a horse, notwithstanding the shaft (?) and blinkers.

Again, criticism is powerless to explain what was meant by some such figure as this, in No. 33. We draw from

memory, but we can answer for it the principal peculiarities are rather softened than exaggerated.

The legs we can especially answer for, while the appendages which come where a horse has his feet and pasterns, are perfect transcripts—they are things we never could forget. We have not the faintest idea what they really are. We would not insult Mr. Whistler by supposing he tried to draw a horse with the customary equine legs, and so failed as to produce these marvels. Perhaps Dr. Wilson knows of some animal limbed thus strangely.

It is because of such insults as these to common sense and common understanding, and from no ill-will we bear him, that we refuse seriously to criticise such work as Mr. Whistler has recently brought before the public. Whatever in it is good adds to his offence, for it shows the offence to be wilful, if not premeditated.

Mr. Whistler, who sometimes nearly draws correctly, and the host of those, from the late Mr. Rossetti downwards, who cannot draw at all, probably look with contempt on honest John Leech. To him was offered what Mr. Oscar Wilde regards as the supreme insult (the only insult not yet offered to Mr. Whistler) *popularity*. Leech was popular because he was HONEST. He took the public fancy, at the beginning of his career, rather by the promise of good things than by what he actually did. There was a good deal of incorrect drawing in his earliest sketches; but as time went on he steadily advanced, till at last he acquired the mastery which characterised unfailingly the last ten years of his work. One of his drawings of a breezy landscape, with men and women and dogs and horses, was worth —to our mind—Mr. Whistler's whole collection of etchings (when due deduction is made from the good points on account of those features which cause real pain to the artistic mind). We venture—we trust *Mr. Punch* will forgive us—to draw a slight sketch from one of Punch's Almanacs, to give our readers relief after the monstrosities we have recalled above.

A reminiscence of dear J. L.

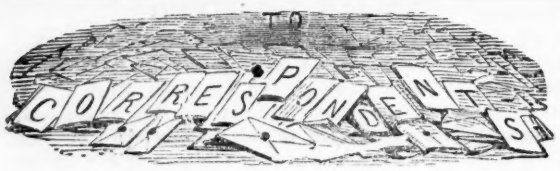
Part XVII. of KNOWLEDGE (containing Nos. 70 to 74 inclusive) is now ready, price 1s.

SERIALS RECEIVED.

The Welcome, for April, 1883 (S. W. Partridge & Co., London). A capital sixpence worth. It contains good likenesses of Rosa Bonheur and Mr. John Ruskin, and many admirable engravings. (The picture, Chestnut-street, Colorado, gives a good idea of this mining city; but the description gives little idea of the wildness of life there.) *The Welcome* ought to be welcome.—*The Sidereal Messenger*, December, 1882 (Northfield, Minnesota). This little magazine contains chiefly borrowed articles and editorial notes. A paper from KNOWLEDGE, on Comet 1882, should not have been reprinted without some remark to the effect that the observations on which Mr. Proctor based his opinion respecting the speedy return of the comet were inexact.—*The Medical Press and Circular.* Full, as usual, of useful information and interesting medical matter. — *The Scientific American.* Always good. — *Cassell's Dictionary of Cookery* (Part I.). We shall have more to say of this later; at present we only note that it promises to be the most complete and valuable work of the kind yet published. Regarded merely as scientific reading, it is full of interest; but no one who wishes to see economy and common sense in the kitchen, and wholesome and pleasant food on the table, should leave unstudied such science problems as are here considered, and as Mr. W. M. Williams is discussing in his papers on the "Chemistry of Cookery" in our columns.—*The Leopold Shakespeare.* Part X. (Cassell's). This completes the issue of a really useful, convenient, and cheap edition of Shakespeare. We shall have occasion to review at length the complete work. Of this part we simply note that, besides "Cymbeline," "Henry VIII.," and "The Tempest," it contains two most interesting plays (portions of which are certainly from Shakespeare's pen), "The Two Noble Kinsmen," and "Edward III."—*The Library of English Literature*, by Henry Morley (Cassell's), parts 2 and 3,—a perfect godsend for young students of literature, who (as is the case with most), cannot afford time to study more than a portion of the works of British authors. Here suitably selected matter from authors of the fifteenth and sixteenth century is judiciously provided with just that amount of old and quaint illustration which is necessary to make the lesson from that era of British literature complete.—*History of the Franco-German War*, by Edm. Ollier (Cassell's), parts 2 and 3. An interesting and well-illustrated account of the most remarkable war of modern times, to be completed in 24 parts, price 6d. each.

(To be continued.)

THE increasing importance of colonies to all countries possessing them has already invested the forthcoming exhibition at Amsterdam with unusual interest. The exhibition is to open on May 1, and will surpass any previous show of colonial products ever attempted in Europe. All the colonies of the world, with but a few exceptions, are to be represented, and, strangely enough, some of these exceptions, due to a singular parsimony, are furnished by Great Britain herself, that fruitful mother of world-wide sentiments. It is believed that the influx to Amsterdam—that Venice of the North—will be very great, and probably this expectation will be realised. Amsterdam—literally, the dyke or dam of Amstel—is a remarkable city, in that it nearly all stands on oaken piles driven deep into the ground, and it is so intersected with canals that 300 bridges hardly suffice for the land traffic. Amsterdam is not a very ancient city. It was founded 1203 A.D., fortified in 1482, and surrendered to Prussia 1787. It was captured by the French in 1795. An epoch in the history of what has always been a great seat of commerce rather than of politics was the opening of the great Industrial Exhibition in 1864. We make no doubt that the Colonial Exhibition of this year will mark another epoch in the history of this singularly industrious city.—P. R.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

STAYS AND FAT.

[774]—For their own sakes, and for that of the forthcoming generation, it is to be hoped that Knowledge has many readers among the fair sex, and that all of them have carefully followed the discussions on stays. The demolition of every argument in favour of these barbaric bandages has been so complete that reasoning readers must be urged to make the effort necessary to overcome the vicious habit of wearing them. The letter by a lady, page 162, shows how it is to be done so cleverly and practically, as to leave no excuse for continuous leaning on the delusive support.

The letter of "Lennox Browne, F.R.C.S." supplies a further argument beyond that which he has used. The tight-lacing variety of the human species care little for health or comfort, and are not much addicted to reasoning; they are not to be warned by any demonstration of damaged lungs, weakened muscles and congested brains, but there is one horror which none can bear to contemplate—viz., fat.

What is fat? It is an accumulation of unburnt body-fuel. How can we get rid of it when accumulated in excess? Simply by burning it away—this burning being done by means of the oxygen inhaled by the lungs. If, as Mr. Browne has shown, a lady with normal lung capacity of 125 cubic inches, reduces this to 78 inches by means of her stays, and attains 118 inches all at once on leaving them off, it is certain that her prospects of becoming fat and flabby, as she advances towards middle age, are greatly increased by tight-lacing and the consequent suppression of natural respiration.

Formerly, when I lectured to ladies on Philosophy and the Laws of Health, I displayed the well-known features of the Venus de Medici, and the victim of tight-lacing, with her contracted waist and crushed ribs. I fear that there were some among my pupils who admired the latter, and drew mental pictures of how a riding habit might be fitted thereon.

It would be well to supplement these by a third picture, showing the effect of suppressed respiration and want of muscular exercise on the figure, when the victim had attained the age of forty, or thereabouts. W. Mattieu Williams.

SATURN'S RINGS.

[775]—Whilst agreeing with Professor Adams that the figure of Saturn and his rings sent to you by me from Vol. I. of "Philosophical Transactions" might have been caused in the way he suggests, I do not think that it was so. The very object of the communication was to call attention to the "notches or hollowness," and to endeavour to find out whether others had observed them. Letters are stated to have been written to "the worthy author of the systeme of this planet, that he would now attentively consider the present figure of his *anses* or *ring* to see *whether the appearance be to him as in this figure.*" If there had been no "notches or hollowness" there would have been nothing to write about. Again, the writer of the notice states that "it was thought fit to insert here the newly-related account," "that other curious men in other places might be engaged to join their observations with him, to see whether they can find the like appearance to that represented here, especially such notches or hollowness as at A and B." All this follows naturally from Ball's expression, "A little hollow above and below." In the number for July 2, 1666, there is another good sketch of Saturn, referring to an observation made by Hook on June 29, 1666. No reference is made to Ball's observation. The communication refers to "black lines crossing the ring and crossing the body" as being plainly perceptible. Hook says, "Whether shadows or not I dispute not." Thos. Ward.

ROTATION OF PLANETS.

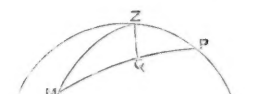
[776]—We are told that the planets are retained in their orbits by the compound action of two mutually opposing forces:—first, the *centripetal* force, or gravitation, by which a body is attracted to the centre of gravity, which, in the case of the planets, is the sun; and secondly, the *centrifugal* force [now generally called tendency, rather than force, R.P.], by which a body in motion tends to proceed in a straight line. But what force causes our planet to revolve on its own imaginary axis, and that with such unvarying speed? If set going at first, like a top from the string, how is it that its speed does not gradually relax, and at length come to an end?

G. M. (Southport).

[The rotation could only be "slowed" by some resisting force. Where is any exerted?]

THE MOON'S VERTEX.

[777]—Perhaps the following considerations may tend to clear up the difficulty expressed by Mr. F. C. Green, at the conclusion of letter 759 (p. 168). Imprimis, the angles of stars from the moon's vertex are given in the fortnightly "Face of the Sky" for Greenwich. Of course, they would vary with change of latitude, &c. In the next place, the great circle passing through the pole and the Moon's centre would only give us the Moon's vertex when she was on the meridian. It would intersect her upper limb at its north point. The method of obtaining the vertex from this—in other words, of finding the angle formed by the intersection of a vertical circle and hour circle, for any latitude, declination, and hour angle of the Moon from the meridian—is a matter of spherical trigonometry, which will be best illustrated by a figure and example.



Here P N is the latitude, which we will call ϕ. P M the Moon's N. Polar distance, the complement of which is her declination δ. Z P M her hour angle, which we call P. Z M, her zenith distance. Then, from Z draw Z Q perpendicular to P M, and call P Q, x. Now, $\cos P = \tan x \cdot \tan \phi$; or, $\tan x = \cos P \cdot \cot \phi$.

Again, $\sin Q M : \sin P Q :: \tan P : \tan M$; or, $\tan M = \dfrac{\sin P N \tan P}{\sin Q M}$

$= \dfrac{\sin x \tan P}{\cos (x + \delta)}$. This angle at M, the one we are seeking, is technically called the parallactic angle. Let us try to make this intelligible by putting our example into figures. In latitude 54° 11′ N, the moon is 4h. 20m. from the meridian, and her North Declination is 16° 30′. What is her parallactic angle? Here we have P = 4h. 20m. = 65°, ϕ = 54° 11′, and δ = 16° 30′.

Then we say cos P 65°	9·625948	sin x 16° 57′ 40″	9·464970
cot ϕ 54° 11′	9·858336	tan P 65°	0·331328
x = 16° 57′ 40″ tan	9·484284	sec $(x + \delta)$ 33° 27′ 40″	0·078699
Parallactic angle = 36° 51′ 57″		tan	9·874997

So that the moon's vertex would be 36° 51′ 57″ from her North Point. It is, of course, needless to remind Mr. Green with reference to the last formula, that multiplying by the secant is the same as dividing by the cosine.

A Fellow of the Royal Astronomical Society.

THE HAMILTONIAN SYSTEM.

[778]—Having read your articles on the Hamiltonian system, and having been anxious to acquire German, I determined to make use of this method. I chose "Robinson der Junger," and this is how I worked. I read over carefully two pages, noting words which were new to me. Then I read these two pages carefully in the original German. The next day I read two more pages, and so

on each day. Gradually I read more than two pages, and read as much as I could without losing interest; but I made it a rule only to read when in the mood. I found this made an immense difference, for when I forced myself at times to read, I had all my trouble over again the next day, my mind not having retained a single word. I have been working now for three months at my leisure, and this is the result,—I have mastered a great many new words, most of the idioms, and have a fair knowledge of the construction of the language. I can also translate at ease, only at times making use of a dictionary.

I think this is a great deal gained, with very little trouble, and in a short time. I had learnt German for nearly four years, after the usual method, and at the end of that time, though I had worked hard, I could not translate a a page of German without a great deal of trouble. M. P.

RETROCESSION OF THE SEA.

[779]—I do not believe that "A Southport Resident" is correct in saying that there has been no retrocession of the sea for the last fifty years. My own opinion is that the sand is gradually but surely gaining on the sea, and has been so doing for a long period. At the present moment the Corporation of Southport are petitioning against Preston being allowed to build a sea-wall at the entrance to the estuary of the Ribble, and are stating that if this should be done the shallow channel leading to Southport Pier would be silted up very quickly, and Southport itself left high and dry as an inland town. G. M.

A NEW ZEALAND GUM.

[780]—The following extract from Martin's "British Colonies" contains information regarding the above which may be of interest to Mr. Joseph Clark:—

"The habitat of the majestic *Dammara Australis*, or Kauri, is limited to the northern extremity of the North Island, and has a range of less than three degrees of latitude and one degree of longitude; even in these narrow boundaries it is by no means a common tree, but is entirely confined to hilly situations. The smooth, grey, columnar stems measure from thirty to forty feet in circumference, and maintain very nearly the same girth through a length of from sixty to even ninety feet. The crown of the tree, where it is irregularly branched, is small and out of proportion to the trunk; and the foliage is likewise diminutive as compared with the branches.

"The wood is very light in proportion to its great strength and durability; it is, therefore, admirably adapted for spars and masts. The land on which it grows, even when cleared, is useless for occupation, from the rugged nature of the ground, and from the quality of the soil. It is one of the most remarkable phenomena in botany that such an immense tree should flourish where it could scarcely be supposed able to take root. The resin which it exudes is very hard, and forms large solid masses at the base of the tree. It is generally of a whitish colour, but through age and, as it would seem, exposure to the sea-water, it assumes the golden-yellow colour of amber, becomes transparent, and very closely resembles that substance. The Kauri is the only coniferous pine in New Zealand."

W. Moor, Jun.

A NEW NARCISSUS.

[781]—If high art is not beyond your scope, you may find this interesting. The Government School of Art at South Kensington supplies to ladies (for a consideration) drawings of flowers, &c., traced in outline upon velvet or the like, upon which the ladies may embroider with silks of appropriate colours. Such a drawing in outline on black velvet has just been shown to me by a lady. It represents a group of bulbous flowers—tulip, narcissus, &c. A narcissus, plainly indicated by foliage, stalk, nectary, &c., is drawn with five petals—a plain, unabashed, full-faced pentagon! Can you tell me whether this is high art? It certainly is not nature.

G. O. E.

A VEIN THEORY IN BOTANY.

[782]—Although the most important function of your journal may be the diffusion of knowledge, yet I hope you will hold it pardonable for me to ask you to give publication to a point of a scientific lecture, of a kind which I should have hoped was well-nigh obsolete in these days of well-weighed facts. The lecture was given by Mr. A. Tylor at the London Institution on Monday, the 19th inst; the title, "Æstheticism, as Displayed by Animals and Plants." The one good point was found in the illustrations, which were well executed, but the lecture was frivolous in the extreme. For nearly half-an-hour had we to listen to such nonsense as this: Mr. Tylor stated that the somewhat zigzag course pursued by the midrib of a leaf was caused by the force of the current from the alternate veins on either side, and illustrated it by reference to the fact that the course of a river is so influenced by tributary streams. One would have thought that a minute's consideration would have shown him that during the composition of the leaf the current runs the wrong way for his fact. He might, like Washington Irving's philosopher, who, finding that the world would not accommodate itself to his theory of revolution, wisely determine to accommodate his theory to the world.

The phantom theory above alluded to was reiterated with wearisome pertinacity; indeed, had not Mr. Tylor made this the chief point in his lecture, it would not have been worth writing about; but such a statement, given with such assurance in the London Institution, might mislead many who listened to learn. The rest of the time was mainly devoted to a narration of a few plain natural facts, without any attempt being made to demonstrate *why* things were so. C. M. A.

POTATOES.

[783]—In Vol. I., Nos. 20 and 29, "Farmer" states his belief that the unpalatableness of frozen potatoes is due to the "frost coming out," for when the potatoes are roasted they will be good food, but not if only boiled. It is somewhat difficult to understand what is exactly meant by the expression "frost coming out," but though it is in common use, yet the idea that it conveys to my mind is but vague.

However, as "Farmer" seems to be interested in the subject, I will put before him the chief points in the latest researches made in this direction by Dr. H. Müller.

The interior parts of the potato are not frozen until the temperature has sunk to 26·6° F., and if this temperature has been rapidly and suddenly attained, as by exposure to the open air, sugar is not formed, but on the other hand when the tuber is but slowly cooled down to its freezing point, a formation of sugar is observed; it is not necessary for this production that the actual freezing point be reached, but only that the temperature should slowly and gradually sink; also the conversion of the starch proceeds at all temperatures between 32° and 26·6°; in one case, potatoes were kept for thirty days at 32°, at the end of which time, 12 per cent. of the starch had been converted, but the actual amount of sugar formed varies with each individual tuber, and those which have the highest percentage of moisture present in them are the more readily sweetened. It has been stated that the alteration of the starch occurs at 32°, but it must not be supposed that there is no change going on at higher temperatures; sugar is formed above 32°, but it will be shown later on why it does not make itself so evident.

Now for the cause of the formation of sugar, and the reasons why it is, so to speak, stored at low temperatures only. There is present in the potato a ferment resembling diastase, or the ferment of malt, which converts starch into sugar at all times, and the product thus formed is required for the growth of the protoplasm; but the cold checks the development of the protoplasm, whilst it has no very appreciable effect in the action of the ferment. Hence sugar continues to be formed, but not consumed, and it is only at comparatively high temperatures that production and consumption are equal, in which case potatoes keep or remain apparently unchanged. The process which thus goes on continuously involves a distinct loss of part of the potato, but it must be remembered that, although loss has occurred, yet the tuber is not valueless, for the principal part of the nourishing portion (the albumen) still remains. It is curious that the sugar so readily disappears when the tubers are kept for some time at a high temperature—say 68°. Knowing this, we may conclude that it is advisable before cooking a sweetened potato to keep it for several hours in a warm place after which it may be cooked, and be indistinguishable from any other; but it is well known that it is useless to boil it while sweet, as only a part of the sugar is removed; moreover, some of the nutritious albumen is at the same time boiled out and lost. Perhaps "Farmer," when making his experiments in boiling and roasting, did not submit both samples to the same previous treatment. With the material at present at hand I do not attempt to account for the great differences which he observed and recorded, but is it not possible that he plunged one of his frozen potatoes straight into the boiling water, whilst the other was kept until such time as the hot wood ashes were ready? I venture to suggest an answer to the query concerning the difference between a waxy and a floury potato, but my suggestions are only founded on a few analyses. In the waxy tuber the water is abnormally high, whilst

the starch is low, and the nitrogenous matter consists nearly wholly of coagulable albumen, there being but little of the other or soluble forms of nitrogen present, as compared with a floury sample. E. W. P.

ANCIENT INSCRIBED STONES.

[784]—Having seen the interesting note about Herr Rödiger's discovery of ancient map-stones in Switzerland (Knowledge, No. 70, March 2), it seems to me that the stones inscribed with circles, dots, lines, &c., which occur in various parts of Ireland, especially in the ancient cemeteries at Newgrange, near Drogheda, and upon the Loughcrew hills (Slieve Na Calliagh of the Ordinance Survey), Co. Meath, may have a similar meaning.

The chief argument against these stones being map-stones is, that they are inside the tumuli, where they form the sides and roofs of passages and cells, in which are found the calcined remains of human beings, supposed to have been sovereigns of Meath and Ulster.

May it not be that a map, showing the territory ruled over by each of these ancient monarchs, was inscribed upon the inner walls which consist of large flags) of their tombs?

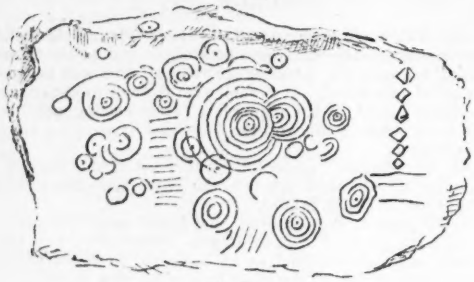


Fig 1

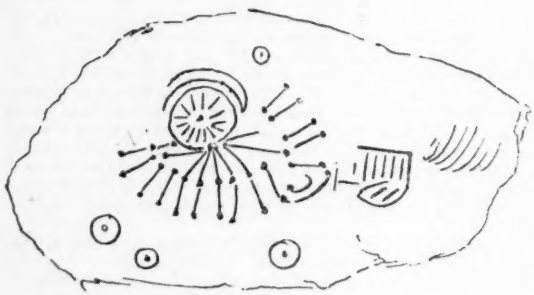


Fig 2

Fig 3

The drawings (Figs. 1 and 2) are from stones on the Loughcrew Hills, and give a good idea of their general appearance.

That these incised markings are not mere ornaments, as I believe is generally supposed, is shown by comparing them with the unmistakable ornamentation upon some bone implements found in one of these tombs.

Fig. 3 is from a drawing of E. Connell's, who was present when the tumuli were opened. It is a fragment of bone, polished, and inscribed with a compass, or some such instrument, and serves to show the difference I referred to. E. C. R., co. Meath.

AMERICAN STAR BICYCLE.

[785]—I presume you will easily recall to mind the lecture you gave when in the United States [My third visit thereto. R. P.] before a small but delighted audience in Matawan, N.J., of your subsequent games of chess [King's Knight's gambit—regular form—pretty pawn finish. R. P.], and your early departure the following morning (Sunday) for New Brunswick, to reach a town in Maine for Monday evening's lecture. The memory of every item, of course, lingers with me rather than with you. [Nay, but I have the clearest recollection of that pleasant evening. R. P.] I remember my receiving "Our Place Among the Infinities," as a sort of partial kindly return for a Testament with parallel columns of English and German text, to which I saw you took a liking. Your paper interests me much, from whist and chess, to logic, mathematics, and astronomy. The articles on bicycles and tricyles have also interested me, especially since I have become an owner of one of the "American Star" kind.

I had given up the idea, at my time of life, of ever riding a bicycle. I feared the "headers." But when in Washington, D.C., I saw one of the "American Star" pattern, and immediately ordered one (you will see by the enclosed sketch its peculiarities). I received mine in due time, and must say I am delighted with it. It has the little wheel in front, and one *cannot take* a "header." In going down steep hills, I can apply the brake, as hard as I choose, with perfect safety and no fear of a "header." It is easy to mount and to dismount, the backward dismount (so called) being especially easy. It can be propelled with one foot, or both at the same time, like a treadle, or at different times. In coasting (*i.e.*, running by gravity down hill), the legs rest at full length on the pedals, and this is especially pleasing. The wheel is stronger than ordinary bicycles, as the spokes are put in bracing, not like radii. You may feel like printing some items from the enclosed. From actual practice over rough roads, I can fully endorse its different points. I will say, however, that it is not as graceful in motion as the ordinary bicycle; but this I regard as a minor point. I have known expert riders of the "Columbia" to sell their machines and purchase the "Star," especially after severe "headers."

I had intended giving a little item about spiders in my schoolroom, but the length of this forbids. Charles Jacobus.

LETTERS RECEIVED.

J. Parry. Letters received too late: have addressed 3,000 and more, and been heard by all.—Sam. Evans. Lessons not so sound as could have been wished.—Q. E. D. Has C been round B? you say "certainly not": I should say "certainly" without the not.—E. P.—C. Carus-Wilson.—A Canny Scot.—Knowledge.—W. H. Lloyd.—R. H.—N.—Constant Reader.—T. R.—P. Bancroft.—J. Smith.—A. H. Atkins.—R. H. Grey.—X. H.—H. Muirhead.—X. H. or X. R. Pardon me; have never said the question of prayer (in the abstract) was a scientific one.—G. M. (Southport). Please send discount dodge.—H. Stock.—W. Miller.—B. F.—Lunabree. Please apply to Publishers for required number.—J. Mason. Very sorry; the point you note involves serious loss to myself.—G. Hornam.—H. H. French.—A. B.—E. S.—J. G. Hutton.—H. E. Curtis.—F. M. Sutcliffe.—A. B. Briggs—W. H. Wilkinson.—J. A. R.—J. Murray.—Y. G. G.—Original Subscriber.—H. Percival.—Hallyards.—A. E. F.—E. Anderson.—W. G. S. G.—Je veux savoir.—Veritas,—E. W. Narding.—W. H. S. Monck.—F. F.—E. S. Ralling.—S. Biddell.—F. H. E.

The extraordinary cold of March has attracted general notice throughout Europe. Even within the Mediterranean basin intense cold has prevailed, such as is rarely experienced unless among the highest Alps. In the Atlantic, icebergs have been extremely numerous, so much so that one Dundee steamer passed through no less than 250 miles of ocean closely islanded with these dreaded "bergs"—a veritable archipelago of ice. On one occasion no fewer than seventy-nine of these awful, glittering, ghastly mountains were counted from the bridge of the steamer, that with rare good fortune safely threaded her intricate passage through these perilous, "shiny, shifting, fatal cliffs." It is worth noting, by the way, that in the vicinity of the Poles there exist enormous masses of permanent ice, and these have been found in Northern Siberia at a depth of 382 ft. below the surface of the earth. Such enormous masses of never-melting ice may really be reckoned among the solid constituents of the globe; but a question arises whether, were it possible for all this ice to melt, the conformation of the earth at the poles might not be sensibly modified. This by the way. It is remarkable that the strength and hardness of ice augment with the intensity of the cold—so much so, indeed, that an ice cannon made on the ordinary turning lathe was loaded with ¼ lb. of gunpowder, and made to discharge a ball. The calibre was that of the old-fashioned six-pounder, and the thickness of the cannon did not exceed 4 in.—P. R.

Our Mathematical Column.

ABSORPTION OF LIGHT BY AIR.

By Richard A. Proctor.

Problem.—*If in 50 miles of air at uniform density and temperature 1999-2000ths of the sun's rays are intercepted, what is the absorption in the first yard?*

In 50 miles there are 88,000 yards. Let us suppose that ρ is the index of absorption for one yard (in which small distance the absorption must be appreciably constant); by which is signified that for 100 rays which reach any point in the air column traversed by the light, 100 ρ rays pass a yard further. Then, putting as unity the light which enters the 50 miles column of air, the light at the end of the first yard is ρ, at the end of the second it is ρ^2, of the third ρ^3, &c., and of the 88000th it is ρ^{88000}. But only one-2000th of the light remains at the end of the 50 miles. Hence we have—

$$\rho^{88000} = 1/2000$$

$$\text{or } 2000\,\rho^{88000} = 1$$

whence, taking logarithms, we have

$$\log 2000 + 88000 \log \rho = 0,$$

$$\text{or } \log \rho = \frac{-\log 2000}{88000}$$

$$= \frac{-3.3010300}{88000}$$

$$= \frac{\bar{4}.6090600}{88000}$$

$$= \frac{-88000 + 87996.6090600}{88000}$$

$$= \bar{1}.9999615 = \log .99999114$$

wherefore the absorption is a yard in about 886-10000000ths of the light, or roughly, about one 11,300th.

Thus, on the assumption made, we should have in a room eleven yards long (which is a tolerably long room) an absorption of about 1-1000th of the light. Or, as far as absorption is concerned, a light at one end of such a room would send its rays to the other end with a loss of only one in a thousand. Yet (this is for the benefit of the *Oxford Chronicle and Berks and Bucks Gazette* only) a person trying to read a book at night, at one end of a room eleven yards long, by the light of an ordinary paraffin lamp situated at the other end, would find the page illuminated with rather less than 999-1000ths of the light which would fall on the page if he sat only a yard from the lamp.

This is a little inconsistent with the great discovery of Dr. Collins Symons, which astronomers and physicists have agreed in leaving so severely alone. It agrees, however—strange to say—with what we find in the solar system, where the planets are so unkind as to neglect Dr. Symons' discovery, Saturn's disc being positively less luminous (not only as a whole, but intrinsically) than Jupiter's, and Jupiter's than the Moon's, the Moon's than Venus's, and Venus's than Mercury's. So contrary is nature in regard to the theories of paradoxists.

Our Chess Column.

By Mephisto.

SOLUTIONS.

Problem No. 80, by A. J. Maas, p. 171.

1. Q to Kt sq	B takes Q, or		K to B4
2. R to B3	Q to B4	Q takes B ch	K to Kt5 or (*a*)
3. Kt to B2 mate		Q to B3 mate, or (*a*) if 2. K to K4	
		R to B6 dis ch and mate	
	if 1. K to K4 or		K to Q5
2. R to B4 dis ch	K to Q3 or (*a*)	R takes B ch	K to B4 or (*a*)
3. R to B6 mate		3. Q to Kt4 mate	
	(*a*) if 2. K to B4		(*a*) if 2. K to K5
3. Q takes B mate		3. R to B3 dis ch and mate.	

No. 81, by G. W. Mitchell, p. 186.

1. B to B7

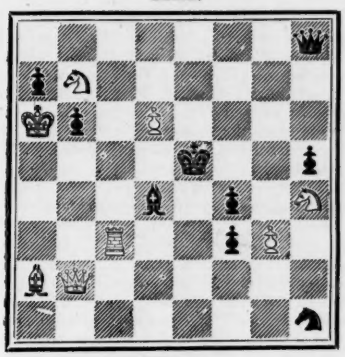
If KR takes Q	2. P takes R dis ch and mate.
If QR takes Q	2. R to Q5 mate
If R takes R	2. Q takes R mate
If R takes Kt	2. Q to B5 mate
If QKt to B3	2. Kt to Q7 mate
If KKt to B3	2. Q to K7 mate, &c.

PROBLEM No. 82.

By A. J. Maas.

(The Twin of No. 80.)

Black.



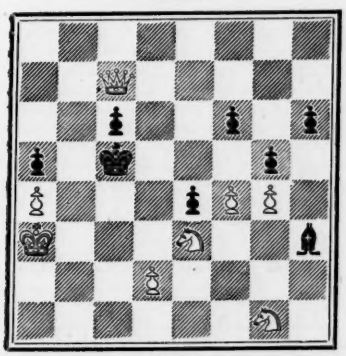
White.

White to play and mate in three moves.

PROBLEM No. 83.

By C. H. Brocklebank.

Black.

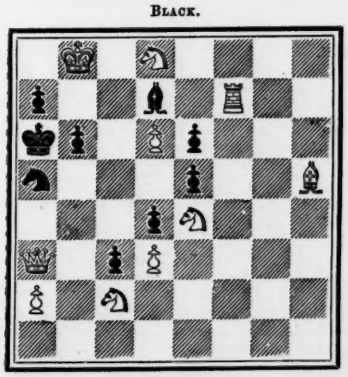


White.

White to play and mate in three moves.

REPRINT PROBLEM No. 84.

Black.



White.

White to play and mate in three moves.

(A test of skill in solving.)

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

M. T. Hooton.—In Problem 79 if 1. R to B sq, B to Kt8 ch. 2. K takes B followed by P and R checking, and no mate in 4

ensues. In the author's solution, if B to R4, 2. Q takes B, then B to Q7, and there is likewise no mate.

H. A. D.—In Problem 80, if 1. Q to Kt4 ch, K to K6. 2. R to B sq, Q to K5, there is no mate on the move.

Alf. Darby, G. W. Thompson.—Problem 81, if 1. B takes Kt, B takes B with a check, spoiling the combination.

Correct solutions received.—Problem No. 79, Delta, Henry Plank. No. 81, J. A. Mayne, Clarence, W., R. J. P., East Marden, Schmucke, H. A. D., John, Berrow, R. W. W., Th. Adamson.

Algernon Bray (New York).—Thanks for letter. The method of pairing players is, as you say, very simple; but it is very useful, and difficult to find out if you do not know it.

A. J. Maas (Switzerland).—Problems received with thanks.

Clarence.—Best thanks for problem.

G. L.—Letter received with thanks.

A Gentleman desires to play by correspondence.

The recent annual general meeting of the Royal National Lifeboat Institution exhibits progress as usual, but progress that is far from adequate to meet the increasing perils of our coasts. During the past year nine new lifeboats were placed on various points of our shores, and it is speaking within bounds to affirm that ninety would not be too many even for present but pressing exigencies. It may not be generally known, perhaps, that the year after next will be the first centenary of the lifeboat. The earliest patent known for a lifeboat was granted in 1785 to Mr. Lukin, but nothing came of this to much purpose until three years after, when Mr. Henry Greathead, of South Shields, won a reward offered by a committee of that town for a practical lifeboat. This fairly opened the way, and by 1804 thirty-one lifeboats had been built and about 300 lives saved by their agency. The next special stimulus given to this form of benevolent invention was imparted by the Duke of Northumberland, who offered a hundred guineas for a still more improved lifeboat, a prize won in 1851 by Mr. James Beeching, of Yarmouth. The following year Mr. H. Richardson invented his tubular lifeboat, and cruised in it from London to Liverpool. This feat was, however, entirely eclipsed by three daring Americans, Messrs. Mikes, Miller, and Mullane, who in a life-raft, composed of cylinders securely fastened together, started from New York on June 4, 1867, and reached Southampton on July 25 following.

Our Paradox Corner.

THE FLAT EARTH THEORY.

MR. HAMPDEN being dissatisfied with our omission of those portions of his "articles" which seemed to us wanting in explanatory or descriptive value, and to be merely vague denunciation of the accepted views, wrote to us the following cheerful letter:—

"Dear Sir,—I gave you most distinctly to understand that any exhibition of bad faith in the treatment of my articles would compel me to denounce and expose as severely as I have the conduct of that degraded swindler, —— ——— ——" [the name is given of an eminent man of science who, somehow, continues to be held in great respect and esteem, despite Mr. Hampden's denunciation and exposure]. "I did not ask for the insertion of my notes; and you have no one to blame but yourself, when you find that your contemptible cowardice has entailed upon you a merciless retribution. Your daring to expunge four-fifths of my articles, under the lying pretence that they were denunciatory, is quite on a par with what my friends told me I should be sure to meet with at your hands. You have, I am sorry to say, a *most* unenviable reputation. Such I would not have for a thousand a year. By giving those lectures in the St. James's Hall, you know that every shilling you take is obtained by false pretences. Every statement you make you know to be a lie; and, before you have finished them, I will compel you to confess it. No one but a mean, contemptible coward would dare to tie his opponent's hands, and forbid him to say a single word in reference to his adversary's statements. How can you wonder at the growing contempt your infidel science is universally provoking? It is you, and such liars and swindlers as" [the above-mentioned eminent man of science], "that have brought the very name of science into ridicule and derision. Go and ask that degraded thief" [our earth-flattener is outspoken] "what his villainy has done for him; and before you are many months older you shall be as ashamed to show your face as he is. Remember my words. If others are afraid to tell you what you are, I am not. I have proved you to be a liar and a coward, and so I shall speak of you.—Yours, &c.,

JOHN HAMPDEN."

Here is the omitted passage from the second article. What appears at p. 185 followed immediately after this passage, and completed the article:—

"I will now proceed with my objections to the globular theory, and unless I am allowed to do this, it will compel me to adopt a method in the conduct of the debate which no sound controversialist would venture to employ. And my point is gained if I can prove the fallacy of the Newtonian system. The mathematical cosmogony of the modern professor has stood its ground as a part of our educational systems for the last century and a half, simply because its supporters have persistently refused to be called to any account, or to give any explanation, of the grounds on which their chimerical hypothesis was originally framed. Many are so apt to think it a display of learning to 'know' what they do not understand, and to accept the most flimsy plausibilities for genuine facts, that to ask them a reason for their scientific belief is generally regarded as an offence, and as a slur upon their understandings. It is this ground upon which I must take my stand; and until I can bring my opponents to their sounder senses, and induce them to confess that much of what they 'know' is nothing but hearsay, and that the authority of others is their only creed, I should be but putting colours before a blind man, or arguments before an empty chair. If a man tells me he has been to the top of a tower with no visible means of ascent, I have a right to ask him how he reached it. If I go to a patent agent and require some security for turning mud into marble, I am expected to show or explain how the metamorphosis is produced. So when I am told that some one has discovered this earth to be a 'globe or oblate spheroid,' I am perfectly justified in asking where that globe is to be seen, and *how* the inventor came to make the discovery. Surely the man who asserts positively it *is* a globe, ought to be able to tell me *how* he obtained the information, that I may know it too.

"Now, I say that the most learned professor in Europe cannot tell me *how* he knows it. And I am called a simpleton because I do not choose to place implicit reliance upon what Jones or Smith choose to believe. I have searched all the books on astronomy that were ever written for some authority which would explain the ground of Newton's conjectures, but in vain. But I have met with scores of authors who have denounced his whimsical theories in much stronger language than ever I have ventured to employ. If this ingenious theory has existed in the schoolrooms of England for 150 years, some of the teachers ought to be able to tell their pupils how its truth has been proved. Newton should have referred his disciples to facts, and not alone to figures. A boy can show me plenty of figures on his copy book or slate; but I want to see the cash those figures represent. Am I to be called a dunce because I do not choose to accept his pencillings for pounds? Then I am told to look up to the moon to see the shape of the world at the moment of an eclipse; but I may learn just as much by looking at the head of a red cabbage.

"I confess I feel ashamed to have to stand up and declare that all the learned men of the day are, on this particular subject, all wrong; but their confusion ought not to dismay me, nor am I responsible for the loss of prestige they have brought upon themselves. Their name is legion, and I am a solitary one. Surely, if numbers can give courage, they ought to be able to crush me by the very rumour of their approach! Goliath cursed David for his presumption in standing on the same battle-field. But the stripling triumphed after all: and, not for the first time, did might succumb to right.

"I am the very last to defend a wrong or to assail a righteous cause. But this widespread and popular delusion has lasted as it has done for the lack of a little moral courage to look it fairly in the face. It has existed on sufferance, and served its turn as an ingenious display of mathematical skill, just as bank paper is more convenient and portable than heavy coin. But if the coin was not forthcoming when demanded, there would be a storm in the teacup, and many blank faces seen upon 'Change.

"As I said in the beginning of this article, it is not incumbent upon me to prove my case, or to spare my opponents the mortification of being shown that they have not a leg to stand on, or a single fact to which they dare appeal. I have no wish or occasion to resort to 'denunciation.'"

In the meantime we may remark that Mr. Hampden has subsided into silence as regards his promised explanation of his own theory, and this is something gained. Witness the following, which may be regarded as his third and last article:—

"Having been duly warned that I should meet with nothing but bad faith and unfair treatment in the columns of Knowledge, I much regret that I was induced to disregard the cautions of those who doubtless had good reasons for tendering me their advice. When an editor is dishonourable enough to suppress four-fifths of the articles he has volunteered to insert, in order to make room for a tissue of senseless trash, which has nothing whatever to do with my subject,* and which is introduced in direct violation of my original determination, as expressed in my first article—that I positively refused to be dictated to by those who for 300 years had proved themselves the credulous dupes of the most baseless superstition ever imposed upon the credulity of mankind—I now do what numerous friends, and also strangers, advised me to do at the outset—namely, to 'put no faith in any promises made by Mr. Proctor.' His promises on the subject of my articles have been most dishonourably and unjustifiably departed from. The charge of 'denunciation' I most indignantly deny, and no one but a contemptible coward would venture to tie the hands of an opponent, or be mean enough to attempt to draw him into a discussion which he knew well enough no one would pretend to understand. If this statement is not inserted, word for word, I shall be compelled to inform my correspondents how fully justified they were in the cautions they gave me.

"JOHN HAMPDEN."

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* This is rather cool when we consider that the senseless trash consisted of seven questions directly suggested by Mr. Hampden's theory.